

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Frauke Jordt

Application No.: 10/525,590 Group: 1796

371(c) Date: May 24, 2005 Examiner: Duc Truong

Confirmation No.: 4988

For: POLYMER FILM BASED ON POLYAZOLES, AND USES THEREOF

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APPEAL BRIEF

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Sir:

This Appeal Brief is submitted pursuant to the Notice of Appeal received in the U.S. Patent and Trademark Office on February 3, 2010, and in support of the appeal from the rejections set forth in the Office Actions mailed on June 5, 2008, February 25, 2009 and September 21, 2009. The fee for filing a brief in support of an appeal is enclosed.

I. REAL PARTY IN INTEREST

The real party in interest is BASF Fuel Cell GmbH, Industriepark Höchst, Frankfurt-Am-Main, Germany, D-65926. BASF Fuel Cell GmbH is the Assignee of the entire right, title and interest in the subject application, by virtue of an Assignment recorded on February 11, 2008 at Reel 020491, Frames 0582-0586.

II. RELATED APPEALS AND INTERFERENCES

Appellants, the undersigned Attorney, and Assignee are not aware of any related appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 25 through 46 and 48 through 51 have been twice rejected, and a copy of these claims appears in the Appendix of this Brief. Original Claims 1 through 24 and Claim 47 were cancelled. Claims 25-51, introduced by the Preliminary Amendment filed February 25, 2005, were amended in the Amendment filed on December 5, 2008. Claims 25 through 26 and 48 through 51 are being appealed herein.

IV. STATUS OF AMENDMENTS

No amendments have been filed after the Final Office Action mailed on February 25, 2009.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Appellants' invention, relates to polyazole-based polymers and its uses.

In one embodiment, as set forth in independent Claim 25, the polyazole-based polymer is produced as a film obtained by a process comprising the steps of (A) mixing one or more aromatic tetraamino compounds with one or more aromatic carboxylic acids or esters thereof which contain at least two acid groups per carboxylic acid monomer, or mixing of one or more aromatic or heteroaromatic diaminocarboxylic acids, in polyphosphoric acid to form a solution or dispersion, (B) applying a layer using the mixture from step (A) to a support, (C) heating the layer obtained according to step (B) under inert gas at temperatures of up to 350°C to form a polyazole polymer, wherein the polyazole polymer has an intrinsic viscosity of at least 1.4 dl/g, (D) treating the polymer film formed in step (C) until it is self-supporting, (E) detaching the polymer film formed in step (D) from the support, (F) removing the polyphosphoric acid or phosphoric acid present and drying. Support for Claim 25 can be found, for example, on page 1, line 32 through page 2, line 8, on page 15, lines 7-10 and page 20, lines 36-39 of the English translation of the specification as filed.

In another embodiment, as set forth in Claim 48, dependent on Claim 37, but which should be considered as an independent claim, the polyazole-based polymer is produced as a

fiber based on polyazoles of Claim 37 whose intrinsic viscosity is at least 1.4 dl/g and which is obtained by a process comprising the steps of (A) mixing one or more aromatic tetraamino compounds with one or more aromatic carboxylic acids or esters thereof which contain at least two acid groups per carboxylic acid monomer, or mixing of one or more aromatic or heteroaromatic diaminocarboxylic acids, in polyphosphoric acid to form a solution or dispersion, (B) heating the mixture from step (A) at temperatures of up to 350°C to form the polyazole polymer, (C) extruding the polyazole polymer formed in step (B) to form fibers, (D) introducing the fibers formed in step (C) into a bath of liquid, (E) isolating and drying of the fibers obtained. Support for Claim 48 can be found, for example, on page 22, lines 5-17 and on page 15, lines 7-10 and page 20, lines 36-39 of the English translation of the specification as filed. The polyazole-based polymers of Claim 37 are described, for example, on page 4, line 29 through page 10, line 8.

VI. GROUNDINGS OF REJECTION TO BE REVIEWED ON APPEAL

Issue A: Whether Claim 25-46 and 48-51 are properly rejected under 35 U.S.C. §102(a) and §102(e) as being anticipated by or, in the alternative, as being obvious over, WO 02/36249 (“ ’249 application”), for the reasons of record.

Issue B: Whether Claims 25-46 and 48-51 are properly rejected under 35 U.S.C. §102(b) as being anticipated by or, in the alternative, as being obvious over, EP 0265921 (“the ’921 application”), for the reasons of record.

VII. ARGUMENT

Issue A: Whether Claim 25-46 and 48-51 are properly rejected under 35 U.S.C. §102(a) and §102(e) as being anticipated by or, in the alternative, as being obvious over, WO 02/36249 (“ ’249 application”), for the reasons of record.

Claim 25-46 and 48-51 are rejected under 35 U.S.C. §102(a) and §102(e) as being anticipated by or, in the alternative, as being obvious over, WO 02/36249 (“ ’249 application”). Specifically, the Examiner stated that ’249 application discloses a single-layered or multi-layered plastic membrane doped with acid. The layer disclosed in the ’249 application is composed of

polyazole subunits disclosed in the instant application (the '249 application, formula 1C at page 6 and Claim 3 at page 19).

Applicants' base claims are drawn in the process-by-product format. The Examiner's rejection of these claims is based on the description in the cited references of a process that employs similar *starting* materials. The steps employed by the cited references, however, are described to be different from the steps recited in Claims 25 and 48. The proper inquiry into patentability of a product-by-process claims is whether the *material differences* between the Applicants' *products* and those of the cited references exist. Absence of the steps recited in the pending claims from the process described in the cited references results in material differences between the products of the cited references and those of Applicants.

M.P.E.P. §2113 states regarding product-by-process claims:

The structure implied by the process steps should be considered when assessing the patentability of product-by-process claims over the prior art [...]
(*Emphasis added.*)

In *In re Garnero*, 412 F.2d 276, 162 USPQ 221 (CCPA 1979), which is quoted in M.P.E.P. §2113, the court gave clear guidelines for examination of a product-by-process claim:

The correct inquiry ... is whether the product defined by claim 1 is patentably distinguishable over the [*cited references*] in view of the structural limitation [...]. (*In re Garnero*, 412 F.2d 276 at 279.) (*Emphasis added.*)

In the instant case, *the step of removal of the polyphosphoric or phosphoric acid* from the material defined by Claims 25 and 48 (*i.e.* step (F)) is one of the elements of Applicants' invention. The result of this step is a "structural limitation" of the inventions defined by the pending claims and it provides for "material differences" between Applicants' claimed invention and those of the cited references.

In other words, for the product-by-process Claims 25 or 48 to be patentably distinct over the referenced patents, it is only required that the structure formed as a result of performing the steps recited in Claims 25 or 48 (*i.e.*, a polymer film or fiber based on polyazoles) be different from and non-obvious over that of the cited references.

Applicants submit that the materials disclosed in the '249 application are different from the product produced by the process defined in either Claim 25 or Claim 48 of the instant

application and that, therefore, the '249 application fails to anticipate Claims 25 or Claim 48 as well as claims dependent thereon. The argument presented below refers to Claim 25, but applies equally to Claim 48.

The '249 application membrane is doped with acid; the presence of the acid in the membrane is stated to be important for the improved mechanical and physicochemical properties of the membrane, for example, good proton conductivity (see Exhibit A, page 1, paragraph 8)¹. Exhibit A further states that that “the doped polymer membranes are polymer membranes which due to the presence of dopants display an increased proton conductivity compared to the undoped polymer membranes.” (Exhibit A, page 4, paragraph 45.) Furthermore, Exhibit A teaches that increasing the degree of doping increases the conductivity of the material, and consequently, a doping of 6-12 mole of acid per mole of repeat unit is preferred. (Exhibit A, page 4, paragraph 47 and Table 1.) Exhibit A further states that the preferred dopant is phosphoric acid. (Exhibit A, page 4, paragraph 46.)

In contrast to the membranes of the '249 application, Claim 25 requires “removing the polyphosphoric acid or phosphoric acid present and drying” (Step (F)). Thus, the film that results from practicing the steps recited in Claim 25 is different from the film of the '249 application because Step (F) removes the phosphoric acid that corresponds to the dopant of the '249 application. As a result of the method by which it is produced, the undoped film of the instant invention has a porous structure that is morphologically different from that of the film disclosed in the '249 application, in which the film is doped with acid. For example, instant application, page 19, lines 6-7, states:

During the treatment in step F), solvent replacement leads to the formation of known porous structures.

For the above reason alone, Claim 25 is novel in view of the '249 application. Moreover, Claim 25 now recites that the polyazole polymer formed has an intrinsic viscosity of at least 1.4 dl/g. The '249 application does not teach the intrinsic viscosity of the polymeric films formed therein. Therefore, Claim 25 is novel in view of the '249 application.

¹ With their response to the Office Action issued June 5, 2008, Applicants presented Exhibit A, which is U.S. Application Number 10/399,514, the U.S. National Stage Application of the '249 application. A copy of Exhibit A is also found in the *Evidence appendix*.

Claim 25 is also non-obvious in view of the '249 application because the instant application selects a polyazole polymer with an intrinsic viscosity of at least 1.4 dl/g, which corresponds to the selection of a high molecular weight polyazole polymer. These high molecular weight polyazoles of the instant application have unexpected advantages in mechanical properties and are, therefore, non-obvious in view of the '249 application.

Intrinsic viscosity is defined by IUPAC as:

intrinsic viscosity (of a polymer)

The limiting value of the *reduced viscosity*, η_i/c , or the *inherent viscosity*, η_{inh} , at infinite dilution of the polymer, i.e.

$$[\eta] = \lim_{c \rightarrow 0} (\eta_i/c) = \lim_{c \rightarrow 0} \eta_{inh}$$

Here, c is the concentration of a polymer, and η_i is the *relative viscosity increment*, defined by IPUAC as the ratio of the difference between the viscosities of solution and solvent to the viscosity of the solvent².

The background information on the intrinsic viscosity and its relation to the molecular weight can be found in Exhibits D and E.³ Intrinsic viscosity is related to molecular weight by the Mark-Houwink equation. (See Exhibit D and Exhibit E.) As can be seen from the Mark-Houwink equation, intrinsic viscosity η is directly proportional to the molecular weight M . (See Exhibit D.) Thus, the higher the intrinsic viscosity of a solution of a solute, the higher the molecular weight of the solute that is dissolved in the solution.

Selection of materials with high molecular weight (as evidenced by higher intrinsic viscosity) results in unexpected improvements of the mechanical properties of the claimed polymer film of the instant application. For example, advantages of the high molecular weight claimed process polymer films of the invention include long-term stability and product life, and improved separation behavior. Additionally, the claimed polymer film do not contain impurities

² With their response to the Office Action issued June 5, 2008, Applicants presented Exhibits B and C. Exhibit B is a printout of URLs <http://www.iupac.org/goldbook/I03140.pdf> and Exhibit C is a printout of <http://goldbook.iupac.org/R05283.html>, both last accessed on December 2, 2008. Copies of Exhibits B and C are also found in the *Evidence appendix*.

³ With their response to the Office Action issued June 5, 2008, Applicants presented Exhibit D, J. Brandrup and E.H. Immergut, Polymer Handbook, 3rd Ed., Wiley Interscience (1989), pp. VII/1, and Exhibit E, a Guide on Determination of Molecular Weight, downloaded from the website run by the University of California College of Engineering, at URL <http://www.eng.uc.edu/~gbeaucag/Courses/Characterization/MolecularWeighthtml/MolecularWeight.html> (last accessed December 2, 2008). Copies of Exhibits D and E are also found in the *Evidence appendix*.

which require high cost to remove. This is explained in the instant application, page 18, lines 27-33:

In addition, the polymer film of the invention displays not only the known advantages of separation membranes based on polyazoles, e.g. high thermal stability and resistance to chemicals, but also improved mechanical properties as a result of the relatively high molecular weight. This leads to an increased long-term stability and life and also to improved separation behavior.

In particular, however, these polymer films contain no impurities which can be removed only at high cost or incompletely.

In the view of the above, Claim 25 is novel over the teachings of the '249 application because (a) the polymer films of the '249 application are doped with a dopant, such as phosphoric acid, and therefore different than the undoped as well as porous polymeric film defined by Claim 25; and (b) because the '249 application does not teach the selection of high viscosity, and thus high molecular weight, materials, as required by Claim 25.

Furthermore, the high molecular weight polymer films defined by Claim 25 have unexpected improved mechanical properties. Therefore, Claim 25 is non-obvious over the teachings of the '249 application. Claims 26-46 and 48-51 depend directly or indirectly on independent Claim 25 and, therefore, are also novel and non-obvious.

In view of the objective evidence provided, Appellants respectfully request the rejection be reversed.

Issue B: Whether Claims 25-46 and 48-51 are properly rejected under 35 U.S.C. §102(b) as being anticipated by or, in the alternative, as being obvious over, EP 0265921 ("the '921 application").

Claims 25-46 and 48-51 are rejected under 35 U.S.C. §102(b) as being anticipated by or, in the alternative, as being obvious over, EP 0265921 ("the '921 application"). Specifically, the Examiner stated that the '921 application reference discloses an organic optical component comprising a medium of polybenzimidazole, which is a polyazole disclosed in the instant application (page 3, last formula, page 7, Example II and Claim 8).

Applicants' base claims are drawn in the process-by-product format. The Examiner's rejection of these claims is based on the description in the cited references of a process that employs similar *starting* materials. The steps employed by the cited references, however, are described to be different from the steps recited in Claims 25 and 48. The proper inquiry into patentability of a product-by-process claims is whether the *material differences* between the Applicants' *products* and those of the cited references exist. Absence of the steps recited in the pending claims from the process described in the cited references results in material differences between the products of the cited references and those of Applicants.

M.P.E.P. §2113 states regarding product-by-process claims:

The structure implied by the process steps should be considered when assessing the patentability of product-by-process claims over the prior art [...] (*Emphasis added.*)

In *In re Garnero*, 412 F.2d 276, 162 USPQ 221 (CCPA 1979), which is quoted in M.P.E.P. §2113, the court gave clear guidelines for examination of a product-by-process claim:

The correct inquiry ... is whether the product defined by claim 1 is patentably distinguishable over the [*cited references*] in view of the structural limitation [...]. (*In re Garnero*, 412 F.2d 276 at 279.) (*Emphasis added.*)

In the instant case, *the step of removal of the polyphosphoric or phosphoric acid* from the material defined by Claims 25 and 48 (*i.e.* step (F)) is one of the elements of Applicants' invention. The result of this step is a "structural limitation" of the inventions defined by the pending claims and it provides for "material differences" between Applicants' claimed invention and those of the cited references.

In other words, for the product-by-process Claims 25 or 48 to be patentably distinct over the referenced patents, it is only required that the structure formed as a result of performing the steps recited in Claims 25 or 48 (*i.e.*, a polymer film or fiber based on polyazoles) be different from and non-obvious over that of the cited references.

Applicants submit that the materials disclosed in the '921 application are different from the product produced by the process defined in either Claim 25 or Claim 48 of the instant application and that, therefore, the '921 application fails to anticipate Claims 25 or Claim 48 as

well as claims dependent thereon. The argument presented below refers to Claim 25, but applies equally to Claim 48.

The '921 application discloses optical devices with an organic non-linear optical film. The '921 application discloses in Example II that the preparation of polybenzimidazole (PBI) polymers is done using two-stage solid polymerization process. (The '921 application, page 7, lines 26-57.) The resulting PBI has a *low* molecular weight, reported as inherent (intrinsic) viscosity of 0.95 dl/g, when prepared with a catalyst (page 7, line 51) or 0.56 dl/g, when prepared without a catalyst (7, line 56).

In contrast to the '921 application, the instant invention provides a new class of polymer films based on polyazoles. Claim 25 recites that the polyazole polymer formed has an intrinsic viscosity of at least 1.4 dl/g. The intrinsic viscosity of the polymer films disclosed in the '921 application are lower (*e.g.* 0.56 - 0.95 dl/g) than the polymeric films formed from the claimed process. Therefore, the polymer films of the '921 application are different than the polymer films of the instant application. Moreover, the '921 application does not teach removal of acid to generate membrane films that possess a porous morphology. For the reasons above, Claim 25 is novel in view of the '921 application.

Claim 25 is also non-obvious in view of the '921 application because the materials defined by Claim 25 are a selection of a polyazole polymer with an intrinsic viscosity of at least 1.4 dl/g, which corresponds to the selection of a high molecular weight polyazole polymer. These high molecular weight polyazoles have unexpected advantages in mechanical properties and are, therefore, non-obvious in view of the teachings of the '921 application.

As discussed above, the high intrinsic viscosity corresponds to a high molecular weight of the polyazole polymer formed by the process recited in Claim 25. Selection of the high molecular weight polymer results in unexpected improvements of the mechanical properties of the claimed polymer film. For example, advantages of the high molecular weight polymer films of the invention include long-term stability and product life, and improved separation behavior. Additionally, the claimed polymer film do not contain impurities which require high cost to remove. (The instant application, page 18, lines 27-33.)

In the view of the above, Claim 25 is novel over the '921 application because the polymer film of the '921 application are of a lower molecular weight. Additionally, the films of the '921 application are not treated to remove any acid present to produce a membrane with a

porous morphology as is the result of practicing the steps recited in Claim 25. Therefore, the membranes defined by Claim 25 are different than the films of the '921 application.

Additionally, the high molecular weight polymer films of Claim 25 have unexpected improved mechanical properties. Therefore, Claim 25 is non-obvious over the teachings of the '921 application. Claims 26-46 and 48-51 depend directly or indirectly on independent Claim 25 and, therefore, are also novel and non-obvious.

In view of the objective evidence provided, Appellants respectfully request the rejection be reversed.

Respectfully submitted,

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Dated:

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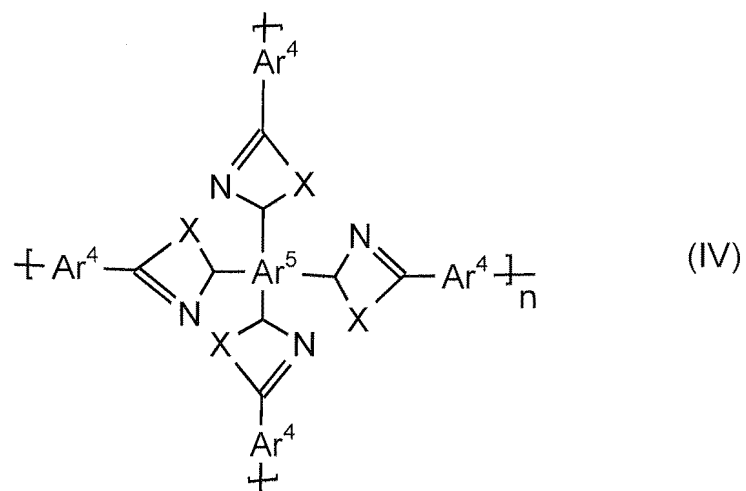
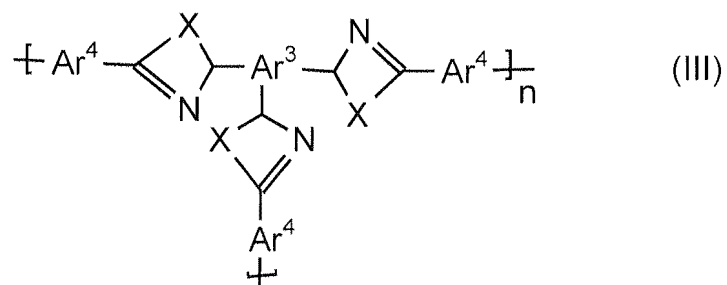
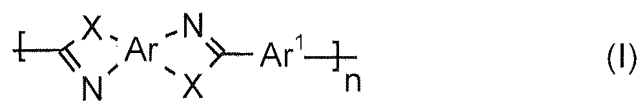
CLAIMS APPENDIX

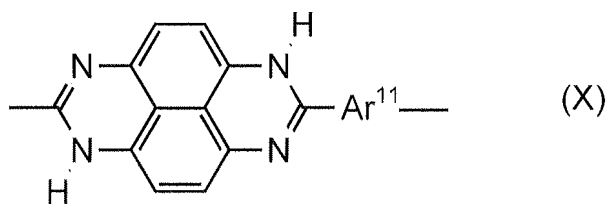
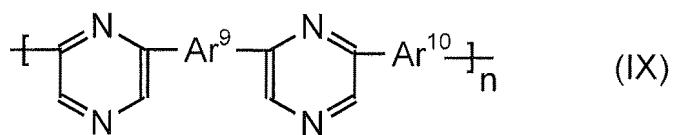
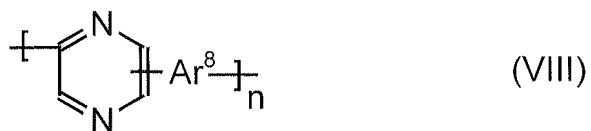
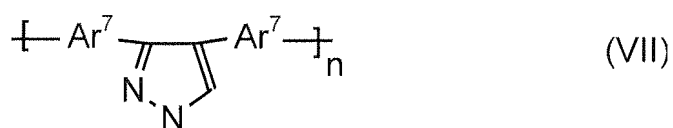
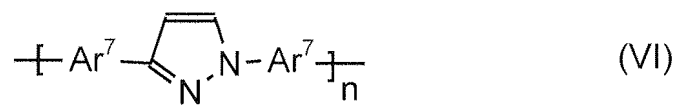
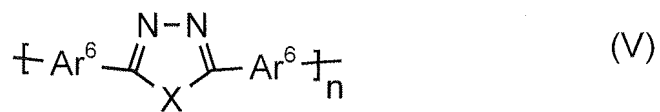
25. A polymer film based on polyazoles which is obtained by a process comprising the steps
- A) mixing one or more aromatic tetraamino compounds with one or more aromatic carboxylic acids or esters thereof which contain at least two acid groups per carboxylic acid monomer, or mixing of one or more aromatic or heteroaromatic diaminocarboxylic acids, in polyphosphoric acid to form a solution or dispersion,
 - B) applying a layer using the mixture from step A) to a support,
 - C) heating the layer obtained according to step B) under inert gas at temperatures of up to 350°C to form a polyazole polymer, wherein the polyazole polymer has an intrinsic viscosity of at least 1.4 dl/g,
 - D) treating the polymer film formed in step C) until it is self-supporting,
 - E) detaching the polymer film formed in step D) from the support,
 - F) removing the polyphosphoric acid or phosphoric acid present and drying.
26. The polymer film of Claim 25, wherein the aromatic tetraamino compounds are selected from the group consisting of 3,3',4,4'-tetraaminobiphenyl, 2,3,5,6-tetraaminopyridine, 1,2,4,5-tetraaminobenzene, bis(3,4-diaminophenyl) sulfone, bis(3,4-diaminophenyl) ether, 3,3',4,4'-tetraaminobenzophenone, 3,3',4,4'-tetraaminodiphenylmethane, and 3,3',4,4'-tetraaminodiphenyldimethylmethane.
27. The polymer film of Claim 25, wherein the aromatic dicarboxylic acids are selected from the group consisting of isophthalic acid, terephthalic acid, phthalic acid, 5-hydroxyisophthalic acid, 4-hydroxyisophthalic acid, 2-hydroxyterephthalic acid, 5-aminoisophthalic acid, 5-N,N-dimethylaminoisophthalic acid, 5-N,N-diethylaminoisophthalic acid, 2,5-dihydroxyterephthalic acid, 2,5-dihydroxyisophthalic acid, 2,3-dihydroxyisophthalic acid, 2,3-dihydroxyphthalic acid, 2,4-dihydroxyphthalic acid, 3,4-dihydroxyphthalic acid, 3-fluorophthalic acid, 5-fluoroisophthalic acid, 2-fluoroterephthalic acid, tetrafluorophthalic acid,

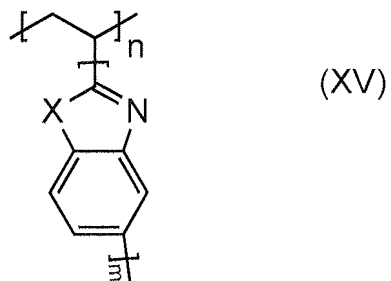
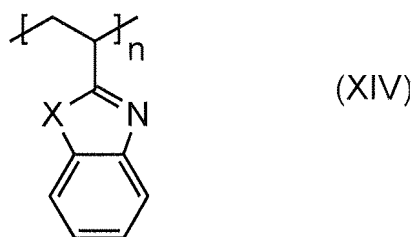
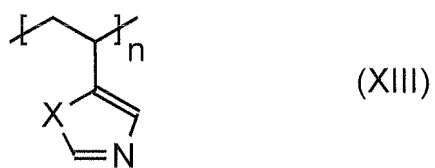
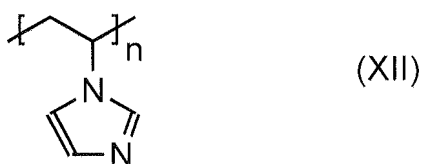
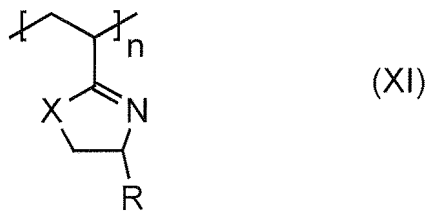
tetrafluoroisophthalic acid, tetrafluoroterephthalic acid, 1,4-naphthalenedicarboxylic acid, 1,5-naphthalenedicarboxylic acid, 2,6-naphthalenedicarboxylic acid, 2,7-naphthalenedicarboxylic acid, diphenic acid, 1,8-dihydroxynaphthalene-3,6-dicarboxylic acid, bis(4-carboxyphenyl) ether, benzophenone-4,4'-dicarboxylic acid, bis(4-carboxyphenyl) sulfone, biphenyl-4,4'-dicarboxylic acid, 4-trifluoromethylphthalic acid, 2,2-bis(4-carboxyphenyl)hexafluoropropane, 4,4'-stilbenedicarboxylic acid, 4-carboxycinnamic acid, their C1-C20-alkyl esters, their C5-C12-aryl esters, their acid anhydrides, and their acid chlorides.

28. The polymer film of Claim 25, wherein the aromatic carboxylic acids are selected from the group consisting of tricarboxylic acids, tetracarboxylic acids, their C1-C20-alkyl esters, their C5-C12-aryl esters, their acid anhydrides, and their acid chlorides.
29. The polymer film of Claim 28, wherein the aromatic carboxylic acids are selected from the group consisting of 1,3,5-benzenetricarboxylic acid (trimesic acid); 1,2,4-benzenetricarboxylic acid (trimellitic acid); (2-carboxyphenyl)iminodiacetic acid; 3,5,3'-biphenyltricarboxylic acid; 3,5,4'-biphenyltricarboxylic acid; and 2,4,6-pyridinetricarboxylic acid.
30. The polymer film of Claim 25, wherein the aromatic carboxylic acids are selected from the group consisting of tetracarboxylic acids, their C1-C20-alkyl esters, their C5-C12-aryl esters, their acid anhydrides, and their acid chlorides.
31. The polymer film of Claim 30, wherein the aromatic carboxylic acids are selected from the group consisting of benzene-1,2,4,5-tetracarboxylic acid, naphthalene-1,4,5,8-tetracarboxylic acid, 3,5,3',5'-biphenyltetracarboxylic acid; benzophenonetetracarboxylic acid, 3,3',4,4'-biphenyltetracarboxylic acid, 2,2',3,3'-biphenyltetracarboxylic acid, 1,2,5,6-naphthalenetetracarboxylic acid, and 1,4,5,8-naphthalenetetracarboxylic acid.

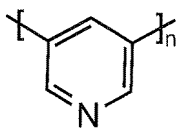
32. The polymer film of Claim 28, wherein the content of tricarboxylic acids and tetracarboxylic acids (based on dicarboxylic acid used) is from 0 to 30 mol%.
33. The polymer film of Claim 25, wherein the heteroaromatic carboxylic acids used are heteroaromatic dicarboxylic acids and tricarboxylic acids and tetracarboxylic acids in which at least one nitrogen, oxygen, sulfur or phosphorus atom is present in the aromatic.
34. The polymer film of Claim 33, wherein the heteroaromatic carboxylic acids used are selected from the group consisting of pyridine-2,5-dicarboxylic acid, pyridine-3,5-dicarboxylic acid, pyridine-2,6-dicarboxylic acid, pyridine-2,4-dicarboxylic acid, 4-phenyl-2,5-pyridinedicarboxylic acid, 3,5-pyrazoledicarboxylic acid, 2,6-pyrimidinedicarboxylic acid, 2,5-pyrazinedicarboxylic acid, 2,4,6-pyridinetricarboxylic acid, benzimidazole-5,6-dicarboxylic acid, their C1-C20-alkyl esters, their C5-C12-aryl esters, their acid anhydrides, and their acid chlorides.
35. The polymer film of Claim 25, wherein a polyphosphoric acid having an assay calculated as P_2O_5 (acidimetric) of at least 83% is used in step A).
36. The polymer film of Claim 25, wherein a solution or a dispersion/suspension is produced in step A).
37. The polymer film of Claim 25, wherein a polyazole-based polymer comprising recurring azole units of one or more of the general formula (I), (II), (III), (IV), (V), (VI), (VII), (VIII), (IX), (X), (XI), (XII), (XIII), (XIV), (XV), (XVI), (XVII), (XVIII), (XIX), (XX), (XXI), or (XXII):



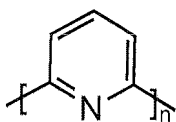




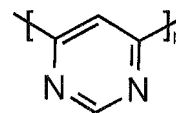
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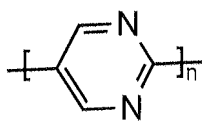
(XVI)



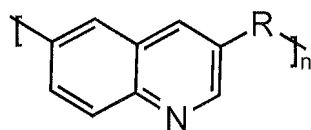
(XVII)



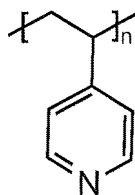
(XVIII)



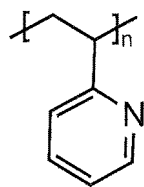
(XIX)



(XX)



(XXI)



(XXII)

where

the radicals Ar are identical or different and are each a tetravalent aromatic or heteroaromatic group which can be monocyclic or polycyclic,

the radicals Ar1 are identical or different and are each a divalent aromatic or heteroaromatic group which can be monocyclic or polycyclic,

the radicals Ar2 are identical or different and are each a divalent or trivalent aromatic or heteroaromatic group which can be monocyclic or polycyclic,

the radicals Ar3 are identical or different and are each a trivalent aromatic or heteroaromatic group which can be monocyclic or polycyclic,

the radicals Ar4 are identical or different and are each a trivalent aromatic or heteroaromatic group which can be monocyclic or polycyclic,

the radicals Ar5 are identical or different and are each a tetravalent aromatic or heteroaromatic group which can be monocyclic or polycyclic,

the radicals Ar6 are identical or different and are each a divalent aromatic or heteroaromatic group which can be monocyclic or polycyclic,

the radicals Ar7 are identical or different and are each a divalent aromatic or heteroaromatic group which can be monocyclic or polycyclic,

the radicals Ar8 are identical or different and are each a trivalent aromatic or heteroaromatic group which can be monocyclic or polycyclic,

the radicals Ar9 are identical or different and are each a divalent or trivalent or tetravalent aromatic or heteroaromatic group which can be monocyclic or polycyclic,

the radicals Ar10 are identical or different and are each a divalent or trivalent aromatic or heteroaromatic group which can be monocyclic or polycyclic,

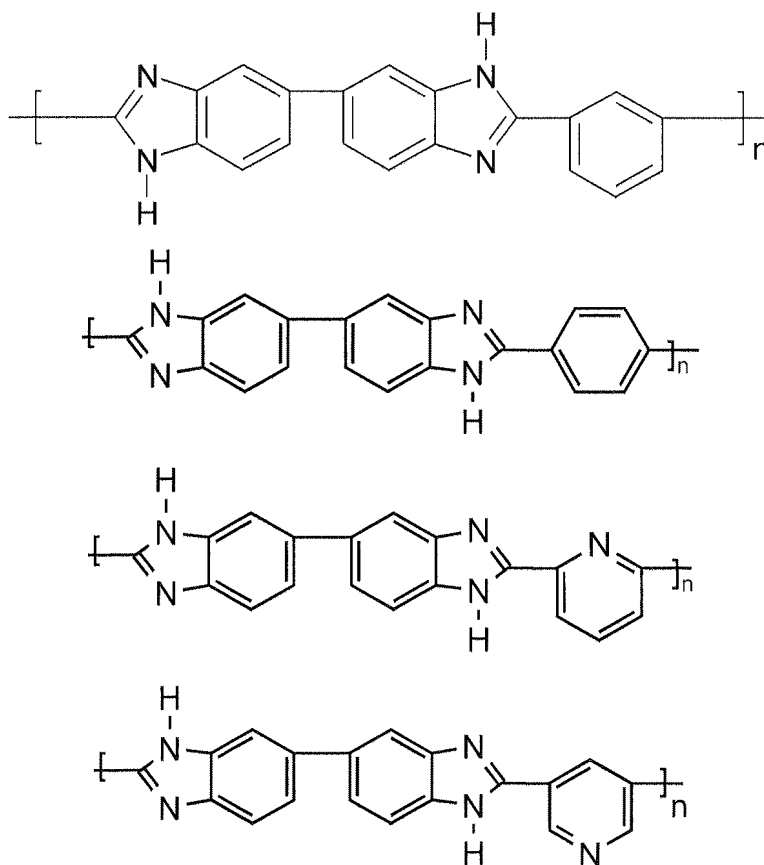
the radicals Ar11 are identical or different and are each a divalent aromatic or heteroaromatic group which can be monocyclic or polycyclic,

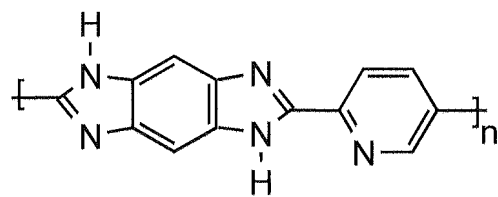
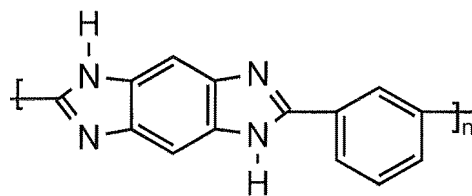
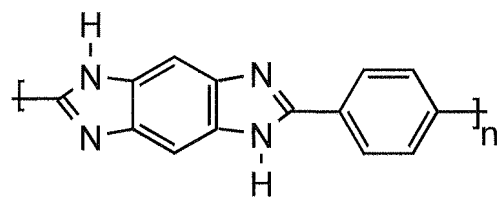
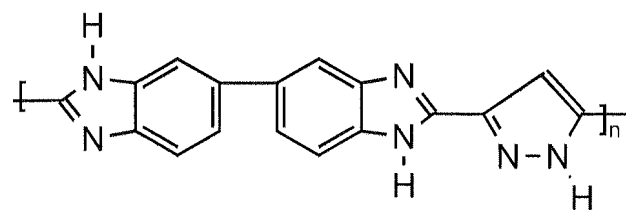
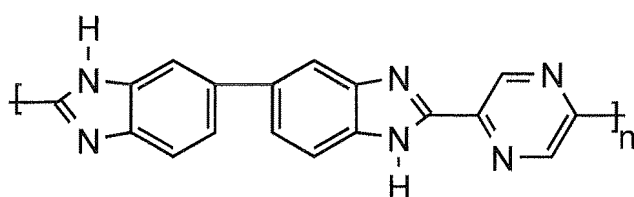
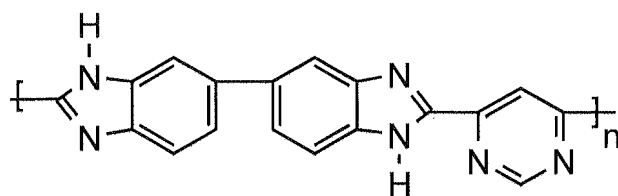
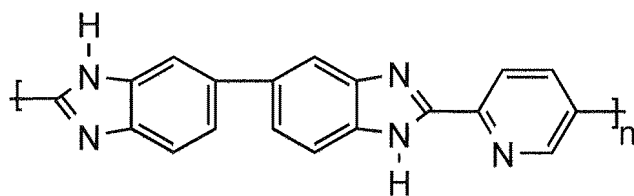
the radicals X are identical or different and are each oxygen, sulfur or an amino group which bears a hydrogen atom, a group having 1-20 carbon atoms, or an aryl group as further radical,

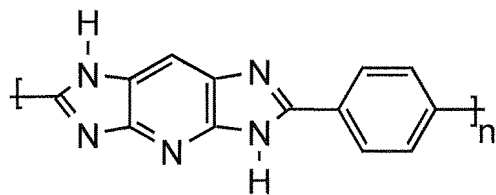
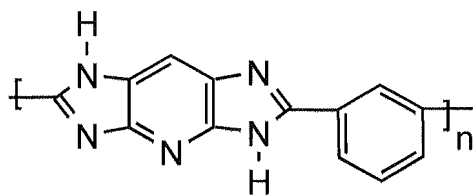
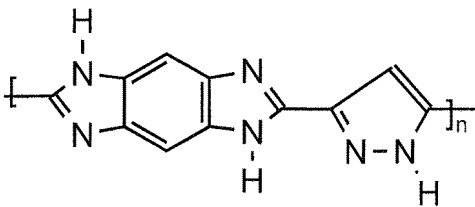
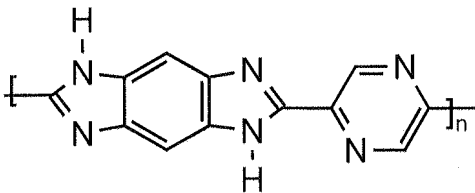
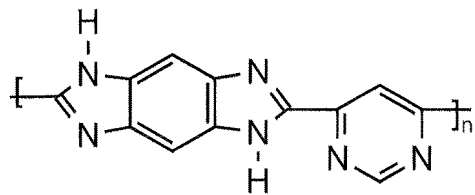
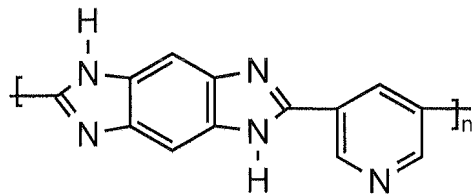
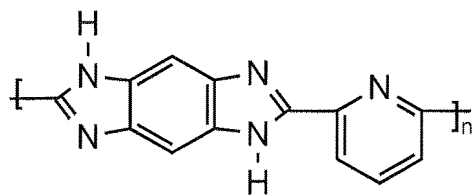
the radicals R are identical or different and are each hydrogen, an alkyl group or an aromatic group, with the proviso that R in the formula (XX) is not hydrogen, and

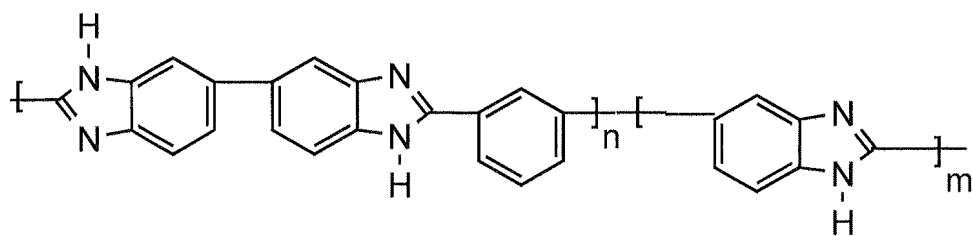
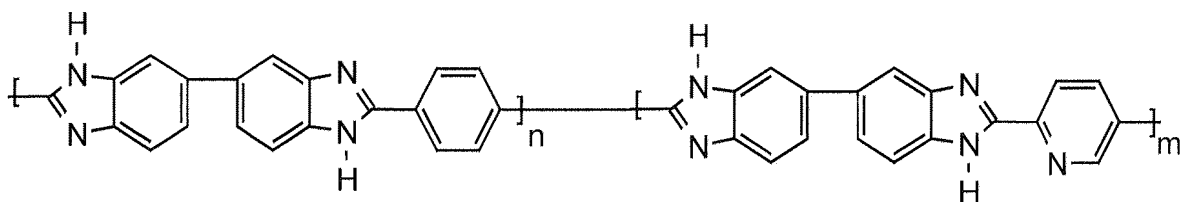
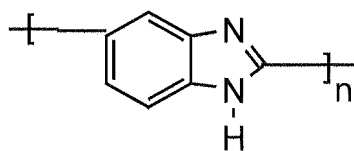
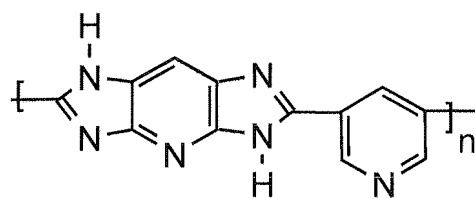
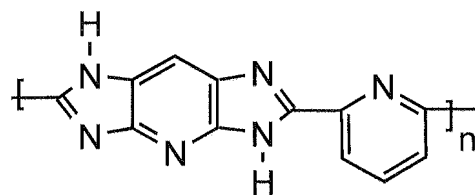
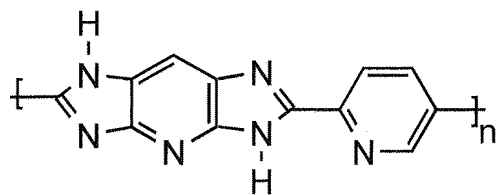
n, m are each an integer greater than or equal to 10,
is formed in step C).

38. The polymer film of Claim 25, wherein a polymer selected from the group consisting of polybenzimidazole, poly(pyridines), poly(pyrimidines), polyimidazoles, polybenzothiazoles, polybenzoxazoles, polyoxadiazoles, polyquinoxalines, polythiadiazoles, and poly(tetrazapyrenes) is formed in step C).
39. The polymer film of Claim 25, wherein a polymer comprising recurring benzimidazole units of the formula









where n and m are each an integer greater than or equal to 10 is formed in step C).

40. The polymer film of Claim 25, further including a step of adjusting the viscosity by addition of phosphoric acid after step A) and before step B).
41. The polymer film of Claim 25, wherein the membrane produced according to step C) is treated in the presence of moisture at temperatures and for a time sufficient for the membrane to be self-supporting and to be able to be detached from the support without damage.
42. The polymer film of Claim 25, wherein the treatment of the membrane in step D) is carried out at temperatures of from greater than 0°C to 150°C in the presence of moisture.
43. The polymer film of Claim 25, wherein the treatment of the membrane in step D) is carried out for from 10 seconds to 300 hours.
44. The polymer film of Claim 25, wherein the removal of the polyphosphoric acid or the phosphoric acid in step F) is carried out by means of a treatment liquid.
45. The polymer film of Claim 25, wherein the treatment in step D) is omitted.
46. The polymer film of Claim 25, wherein the polymer film is not self-supporting after the treatment in step D) and remains on the support for further processing.
48. A polymer fiber based on a polyazoles of Claim 37 whose intrinsic viscosity is at least 1.4 dl/g and which is obtained by a process comprising the steps
 - A) mixing one or more aromatic tetraamino compounds with one or more aromatic carboxylic acids or esters thereof which contain at least two acid groups per carboxylic acid monomer, or mixing of one or more aromatic or heteroaromatic diaminocarboxylic acids, in polyphosphoric acid to form a solution or dispersion,

- B) heating the mixture from step A) at temperatures of up to 350°C to form the polyazole polymer,
 - C) extruding the polyazole polymer formed in step B) to form fibers,
 - D) introducing the fibers formed in step C) into a bath of liquid,
 - E) isolating and drying of the fibers obtained.
49. The polymer fiber of Claim 48, wherein the fibers formed in step C) are introduced into a precipitation bath.
50. The polymer fiber of Claim 48, wherein the polyazole polymer extruded in step C) is saturated with a gas so that the gas forms pores on subsequent expansion.
51. The polymer fiber of Claim 48, wherein the polyazole polymer extruded in step C) is saturated with a gas in a supercritical state so that the gas forms pores on subsequent expansion.

EVIDENCE APPENDIX

- 1) Exhibit A, a copy of U.S. Application Number 10/399,514, which is the U.S. National Stage Application of the '249 application, presented by Applicants with their response to the Office Action issued June 5, 2008.
- 2) Exhibit B, a copy of a printout of URLs <http://www.iupac.org/goldbook/I03140.pdf>, last accessed on December 2, 2008, presented by Applicants with their response to the Office Action issued June 5, 2008.
- 3) Exhibit C, a copy of a printout of <http://goldbook.iupac.org/R05283.html>, last accessed on December 2, 2008, presented by Applicants with their response to the Office Action issued June 5, 2008.
- 4) Exhibit D, a copy of J. Brandrup and E.H. Immergut, Polymer Handbook, 3rd Ed., Wiley Interscience (1989), pp. VII/1, presented by Applicants with their response to the Office Action issued June 5, 2008.
- 5) Exhibit E, a Guide on Determination of Molecular Weight, downloaded from the website run by the University of California College of Engineering, at URL <http://www.eng.uc.edu/~gbeaucag/Classes/Characterization/MolecularWeighthtml/MolecularWeight.html>, last accessed December 2, 2008, presented by Applicants with their response to the Office Action issued June 5, 2008.

RELATED PROCEEDINGS APPENDIX

None.